Trees and Shrubs Existing at the Main Campus of the Islamic University of Gaza, Gaza Strip, Palestine

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Absract- The Gaza Strip, which has a population of about 2.0 million and an area of about 365 km2, has many higher education institutions. The green quadrates, corridors and gardens of these institutions are commonly cultivated with many horticultural plants including trees and shrubs that provide many environmental, health, and aesthetic values. The Palestinian universities of the Gaza Strip have never been studied for the composition and numbers of their trees and shrubs. Therefore, the current study aims at identifying and recording the trees and shrubs prevailing and enhancing the ecology and environmental health aspects of the main campus of the Islamic University of Gaza (MC-IUG). Frequent surveys and observations were carried out during a six-month study extended from February, 2018 to July, 2018 in order to identify and totally count the trees and shrubs existing at MC-IUG. A total number of 2248 trees and shrubs belonging to 53 species, 25 families and 16 orders were identified and recorded at the MC-IUG. The Gymnosperms included 5 species (9.43%) only, while the Angiosperms was represented by 48 species (90.57%), of which the monocots were 9 species (16.98%) and the dicots were 39 species (73.59%). Rosales was the biggest order and comprised 9 (16.98%) of the recorded species. It was followed by Lamiales and Myrtales which comprised 5 (9.43%) for each. The orders Pinales, Arecales, Asparagales and Malpighiales were represented by 4 species (7.55%) for each. Moraceae was the biggest family and comprised 8 (15.09%) of the recorded species. It was followed by the two families Arecaceae and Asparagaceae, which comprised 5 species (9.43% for each). Six tree and shrub species (11.32%) of MC-IUG were found to exceed the threshold of 100 individuals for each. These comprised 1657 individuals (73.71%) of the 2248 counted. The Chinese Hibiscus (Hibiscus rosa-sinensis) was, by far, the most common species. It comprised 31.98% of the individuals counted. This was followed by the Benjamin Fig (Ficus benjamina) (10.45%), Hopbush (Dodonea viscose) and Moringa (Moringa oleifera) (8.63% for each), Dwarf Umbrella Tree (Schefflera arboricola) (8.19%) and Weeping Fig (Ficus nitida) (5.82%). The majority of tree and shrub species 49 (92.45%) recoded in the current study are exotic, while the native ones are restricted to only 4 species (7.55%). Finally, the current study recommends the selection of tree and shrub species corresponding with the local prevailing environmental conditions in order to ensure the ecological and environmental health values needed by the university community.

Keywords: Trees, shrubs, survey, main campus, Islamic University of Gaza, Gaza Strip.

I. INTRODUCTION

Urban gardens are a significant part of sustainable development in cities worldwide. Trees and shrubs are the framework of public and private gardens. The various vascular plant forms of these gardens provide a wide range of services and benefits to both people and the environment. In spite of their values for beauty, shade, shelter and privacy, trees and shrubs of green spaces and public gardens could help improve the life and health status of city inhabitants, serve as sites of physical activity, filter the atmosphere, remove pollutants, attenuate noise, cool temperatures, infiltrate storm water, replenish groundwater, and attract wildlife species; especially bird fauna (Hartig, 2008; Barton and Pretty, 2010; Sister et al., 2010; Escobedo et al., 2011 and Roy et al., 2012). The fruit

trees and shrubs of these gardens can provide food for both humans and wildlife (Abd Rabou, 2011; 2018 and 2019). Many tree and shrub species are very useful in controlling the malaria, which is a common disease in tropical countries (Dharani et al., 2010).

With regard to the difference between trees and shrubs, shrubs are usually much smaller than trees. Botanists usually define a tree as a woody single-stemmed plant that grows over 3 m tall. Gardeners consider any multi-trunked plant less than 5-6 m tall a shrub and any plant over that, multi-trunked or not, a tree (Cheers, 2008). As far as planning the garden is concerned, trees, being by far the longest lived garden plants, should be considered first. Shrubs are often used to fill the spaces left under the trees. Moreover, shrubs tend to be more colorful when in flower and their blooms are closer to eye level (Cheers, 2008). Pruning and trimming are very crucial maintenance methods for both gardens trees and shrubs in order to ensure well-shaped healthy plants. These methods maintain ventilation, which reduces fungus problems, and allows light to penetrate to the center of the shrub or tree.

Palestine (27,000 km2) is home to a great diversity of floristic species because of its strategic geographic position at the meeting point of Asia, Africa and Europe. Ali-Shtayeh and Jamous (2002 and 2003) pointed out that Palestine harbors about 2,700 species of wild plants, with the Compositae, Gramineae, Leguminaceae, Crucifera, Labiatae and Liliaceae are the most common families. The Gaza Strip, which is a small and narrow strip of land (365 km2), lying along the southeastern Mediterranean, is home to a considerable diversity of floristic species dominating everywhere; especially in the well-vegetated ecosystems like Al-Mawasi area, Wadi Gaza and Wadi Beit Hanoun (Madi et al., 2002; Abd Rabou, 2011; Abd Rabou et al., 2008; Palestinian Hydrology Group for Water and Environmental Resources Management, 2008 and Al-Quds Society for Developing Al-Mawasi, 2017). In addition to floristic species represented by trees, shrubs and herbs, the environment of the Gaza Strip is studded with both native and exotic woody plants prevailing at the green spaces like public parks, resorts, public or community gardens and cemeteries (Abd Rabou, 2018).

Local studies dealing with the woody composition of urban communities seem to be very limited. More recently, Abbas (2016) surveyed the median trees and shrubs prevailing in the main streets of the Gaza city which is the biggest in the Gaza Strip. She listed as many as 45 native and exotic tree and shrub species belonging to 25 families and 15 orders. Al-Agha (2016), Radwan (2017) and Abd Rabou and Radwan (2017a) studied the current state and public uses of the Date Palm (Phoenix dactylifera), which is a Quranic and public fruit tree planted in the whole Gaza Strip. They highlighted the importance of the Date Palm as a fruity and horticultural tree in the Gaza Strip. Abd Rabou (2018) surveyed the trees and shrubs existing in three public parks in the Gaza Strip. A total of 50 tree and shrub species were identified. He pointed out that the majority of these woody components are exotic in the sense that they were introduced from outside to the Palestinian environment. More recently, Abd Rabou (2019) surveyed the bird fauna prevailing at the main campus of the Islamic University of Gaza (MC-IUG), which is studded with numerous species of plants including trees, shrubs and herbs.

In contrast, the studies concerning the floristic trees, shrubs and herbs in the Gaza Strip seem to be more abundant than that of horticultural ones. Bolous (1959) listed as many as 251 floristic species occurring in the Gaza Strip. Abd Rabou (2005) and Abd Rabou et al. (2008) described 70 floristic species prevailing in Wadi Gaza Nature Reserve, which lies in the middle of the Gaza Strip. Abou Auda (2010, 2011 and 2012) studied the plant ecology and potential uses of flora in the Gaza Strip; particularly Wadi Gaza. Madi (2001 and 2005) and Madi et al. (2002) identified the flora dominating in the coastal sand dunes of the Gaza Strip. Al-Quds Society for Developing Al-Mawasi (2017) produced a guidebook containing a total of 130 floristic species dominating Al-Mawasi area which is a coastal ecosystem along the southern Gaza Strip. More recently, Dardonah (2018) surveyed 114 medicinal plants prevailing in the medical garden of the University of Palestine, Gaza Strip. Many of the tree and shrub species described in these studies have been found grown in the roads, cemeteries and public gardens of the Gaza Strip.

Although urban trees and shrubs were surveyed in some public gardens and main streets in the Gaza Strip (Abbas, 2016 and Abd Rabou, 2018), they have never been studied or surveyed in the local educational and non-educational institutions of the Gaza Strip. The main campus of the Islamic University of Gaza (MC-IUG) resembles the campuses of other local universities and public gardens in having a diversity of woody components; especially trees and shrubs. Such woody components are very crucial in providing various benefits and values to the IUG community and environment. The current study aims at surveying the trees and shrubs existing at the MC-IUG with their numbers and frequencies are calculated. Such trees and shrubs along with their faunistic components are known to add more beauty to the MC-IUG environment, which in turn will be reflected on the educational level and welfare of university students.

II. MATERIALS AND METHODS

2.1 The Gaza Strip

The Gaza Strip (31°25′N, 34°20′E) is a 365 km2 arid strip of the Palestinian land along the southeastern Mediterranean. About 2.0 million residents, of whom the majority is United Nations-registered refugees, are living in the five governorates of the Gaza Strip (North Gaza, Gaza, Middle, Khan Younis and Rafah). The annual rainfall ranges from 200 mm in the south to 400 mm in the north. The Gaza City (Figure 1) is the largest city in the Gaza Strip. It has a total area of about 56 km2, and a population of about 700,000 people, making it one of the most densely populated cities in the world.

2.2 The Islamic University of Gaza as a study area

The Islamic University of Gaza (IUG), which was established in 1978, is an independent academic institution supervised by the Ministry of Higher Education. The MC-IUG has an area of 82 dunums or 82,000 m2 (one dunum equals 1000 m2) (Figure 2). More than one hundred of academic programs in different disciplines are currently offered by IUG to the Palestinian society. The IUG also provides all available resources, including the most up-to-date technology in service of the education process. It provides its students with an academic atmosphere rich in various types of native and exotic grass, shrub and tree plants (Figure 3). The vegetation cover of MC-IUG attracts bird fauna, which by their existence, color, movement and sounds add more aesthetic values to the place. It is worth mentioning that the IUG has achieved many advanced rankings in the international classification of universities according to the standards of sustainability and green environment. Such standards are crucial in increasing the biodiversity level as well as in enhancing the educational quality.

Figure 1: The position of the Gaza Strip in Palestine, with the location of IUG is presented

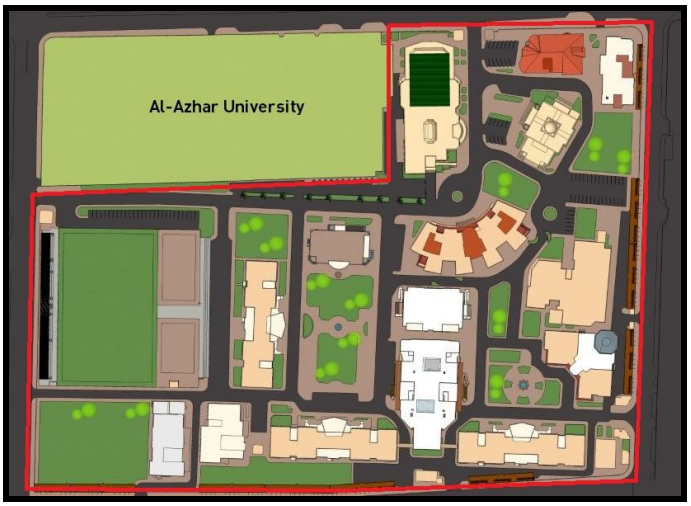

Figure 2: A schematic structure of MC-IUG (82,000 m2), surrounded by red line

Figure 3: The MC-IUG is studded with a diversity of plant forms

2.3 Procedure

A large number of researchers with close scientific and engineering disciplines participated in the preparation of this training study. The researchers carried out frequent visits and observations at MC-IUG during a six-month study extended from February, 2018 to July, 2018 in order to identify and totally count the trees and shrubs existing there. Parameters observed included number of species and individuals. Plant samples such as leaves, twigs, fruits and flowers were sometimes collected, when necessary, for further lab identification. In this regard, a variety of texts and guidebooks were referred to in order to identify the trees and shrubs of MC-IUG (Karim and Quraan, 1986; Madi, 2001 and 2002; Abu Ayyash et al., 2007; Cheers, 2008; Ali-Shtayeh et al., 2003 and 2014 and Supreme Commission for the Development of Riyadh City, 2014).

Counting of trees and shrubs was made possible and facilitated by dividing the area of MC-IUG (82,000 m2) into quadrates of approximately equal sizes, depending on the architectural and horticultural designs of the place. Pre-designed sheets containing a list of the identified plant species were used to ensure that all the trees and shrubs will be totally counted. Interviews with IUG horticulturalists and students were carried out as well to collect more data regarding the woody components of MC-IUG.

2.4 Photography and Statistical Analysis

Professional digital cameras have been used throughout the study period and photos were taken for documentary and confirmatory purposes. The data collected throughout the course of the study were statistically analyzed using SPSS computer program version 18.0 for Windows (Statistical Package for Social Sciences Inc, Chicago, Illinois). Graphs were plotted using Microsoft Excel program 2010.

III. RESULTS

3.1 Species diversity

The current survey pointed out that the targeted MC-IUG harbors ornamental, horticultural, agricultural and even wild woody plant species. A total number of 2248 trees and shrubs belonging to the Gymnosperms (conifers or naked-seeded plants) and Angiosperms (flowering plants) plant groups were identified and recorded. The surveyed trees and shrubs represented 53 species belonging to 26 families and 16 orders (Table 1 and Figures 4, 5, 6 and 7). The Gymnosperms included 5 species (9.43%) only, while the Angiosperms was represented by 48 species (90.57%), of which the monocots were 9 species (16.98%) and the dicots were 39 species (73.59%) (Figure 8). Table 1 also shows that the Rosales was the biggest order and comprised 9 (16.98%) of the recorded species. It was followed by Lamiales and Myrtales which comprised 5 (9.43%) of the recorded species for each. The orders Pinales, Arecales, Asparagales and Malpighiales were represented by 4 species (7.55%) for each. The same table shows that the Moraceae was the biggest family and comprised 8 (15.09%) of the recorded species. It was followed by the two families Arecaceae and Asparagaceae, which comprised 5 species (9.43%) for each.

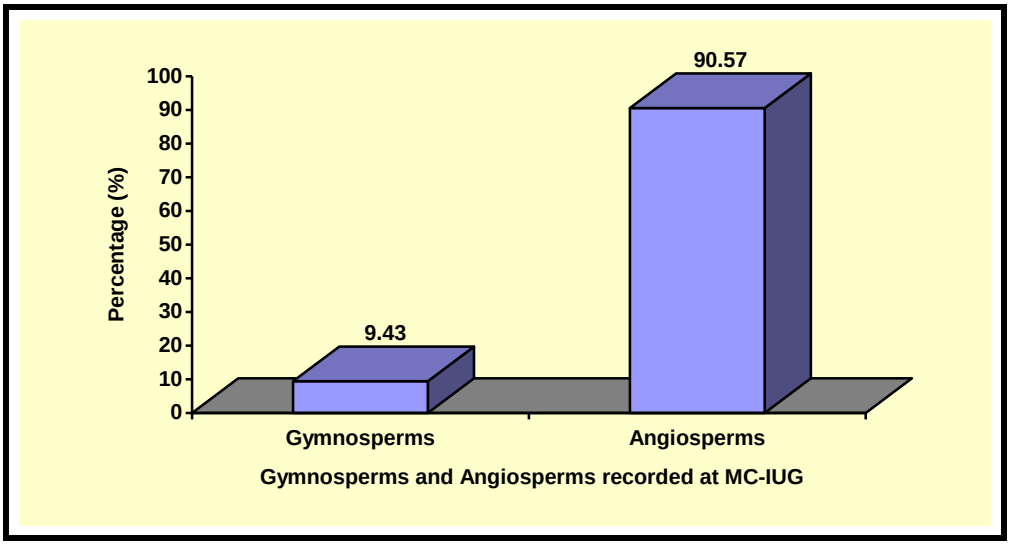

Figure 8: A graphic model showing the percentages of Gymnosperms and Angiosperms (Monocot and Dicot) recorded at MC-IUG

3.2 Number diversity

As far as the numbers of each species are concerned, six tree and shrub species (11.32%) of MC-IUG were found to exceed the threshold of 100 individuals for each (Table 1 and Figure 9). They, in total, comprised 1657 individuals (73.71%) of the 2248 counted. The Chinese Hibiscus or China Rose (Hibiscus rosa-sinensis) was, by far, the most common species among the trees and shrubs of MC-IUG. It comprised 719 individuals (31.98%) of the individuals counted. This was followed by the Benjamin Fig (Ficus benjamina) including its "Starlight" variety 235 (10.45%), Hopbush (Dodonea viscose) and Moringa (Moringa oleifera) 194 (8.63%) for each, Dwarf Umbrella Tree (Schefflera arboricola) 184 (8.19%) and Weeping Fig (Ficus nitida) 131 (5.82%). In contrast, 35 tree and shrub species (66.04%) of MC-IUG were found to comprise 10 individuals or less. Out of the 53 tree and shrub species recoded in the current study, 13 species (24.53%) were counted in ones or twos. A clear example of the trees counted in ones was the Cuban or Florida Royal Palm (Roystonea regia). As its name dictates, the species is an exotic ornamental palm, having a trunk characterized by its stout, smooth and grey-white appearance. There is a characteristic bulge lying below the distinctive and attractive green crownshaft of the palm. The two other species counted in ones were the Guava (Psidium guajava) and the Clementine (Citrus clementina). They are agricultural woody plants that are extensively planted in the Gaza Strip. They and their fruits are very well known to all Gazans.

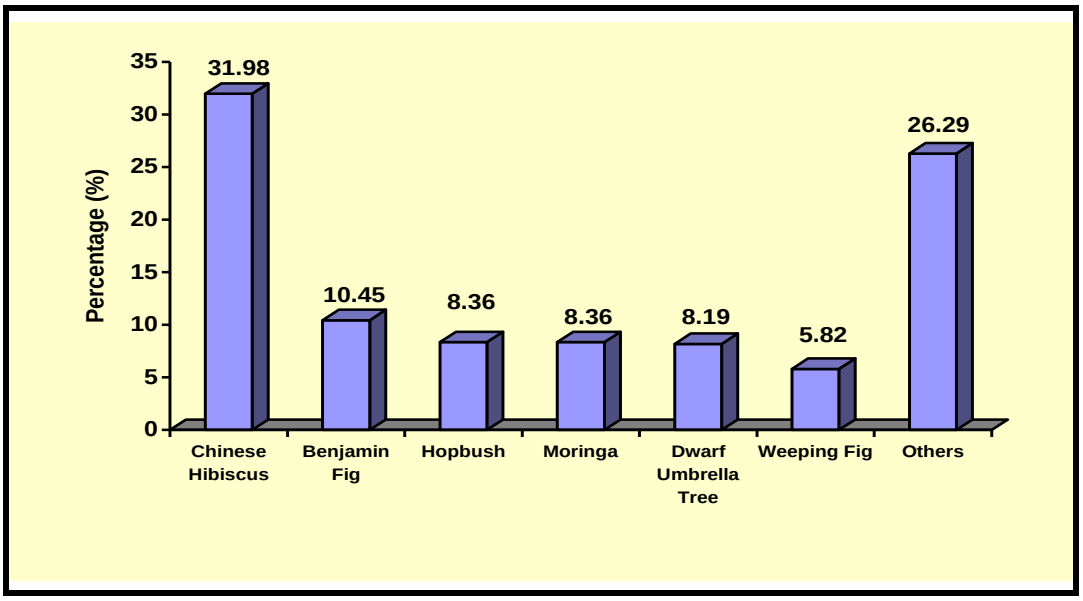

Figure 9: A graphic model showing the most occurring tree and shrub species at MC-IUG (Chinese Hibiscus is the most common species)

3.3 Native vs. exotic species

Native species are plants, animals, or other organisms that have historically occurred and evolved in the Palestinian environment. Exotic or non-native species have been either intentionally or accidentally introduced to the Palestinian environment by humans or their activities. As can be deducted from table 1, the majority of tree and shrub species 49 (92.45%) recoded in the current study are exotic, while the native ones are restricted to only 4 species (7.55%). The native ones are the Oleander (Nerium oleander), Common Fig (Ficus carica), Olive Tree (Olea europea) and Common Jasmine (Jasminum officinale).

Table 1: Tree and shrub species encountered at MC-IUG

Order	Family	Scientific Name	Common Name	Arabic Name	Native vs. Exotic	Number	%
Gymnosperms (عاريات البذور)							
Pinales	Araucariaceae	Araucaria heterophylla	Norfolk Island Pine (Christmas Tree)	شجرة الميلاد	E	25	1.11
	Cupressaceae	Cupressus sempervirens	Evergreen Cypress	السرو	E	43	1.91
		Cupressus macrocarpa	Monterey Cypress	السرو الليموني	E	9	0.40
		Thuja (Platycladus) orientalis	Oriental or Chinese Thuja	سرو الثويا المكوية	E	20	0.89
Cycadales	Cycadaceae	Cycas revoluta	King Sago Palm (Japanese Sago Palm)	نخيل السيكاس المرتد	E	4	0.18
Angiosperms – Monocot (كاسيات البذور – وحيدة الفلقة)							
Arecales	Arecaceae	Phoenix dactylifera	Date Palm	نخيل البلح	E	53	2.36
		Phoenix roebelenii	Pygmy or Miniature Date Palm (Robellini),	النخيل القزمي	E	2	0.09
		Roystonea regia	Cuban or Florida Royal Palm	النخيل الملكي	E	1	0.04
		Washingtonia filifera	California Fan Palm	نخيل واشنطونيا	E	10	0.44
Poales	Cyperaceae	*Cyperus involucratus* (*Cyperus alternifolius*)	Umbrella sedge (Umbrella Papyrus)	السعد المظلي	E	2	0.09
Asparagales	Asparagaceae	Yucca gloriosa	Spanish Dagger	اليوكا	E	16	0.71
		Beaucarnea recurvata (Nolina recurvata)	Elephant's Foot (Ponytail Palm)	النولينا أو رجل الفيل (ذيل البوني)	E	7	0.31
		Dracaena marginata	Madagascar Dragon Tree	الدراسينا (تنينة مدغشقر)	E	5	0.22
		Ruscus hypoglossum	Spineless Butcher's-broom	السفندر (مكنسة النجار)	E	2	0.09
Angiosperms – Dicot (كاسيات البذور – ثنائية الفلقة)							
Gentianales	Apocynaceae	Nerium oleander	Oleander	الدفلة (ورد الحمار)	N	11	0.49
		Cascabela thevetia	Yellow Oleander	الدفلة الصفراء	E	5	0.22
		Carissa macrocarpa	Num-num	الكريسة (الياسمين الهندي)	E	3	0.13
Fabales	Leguminosae	Acacia cyanophylla (Acacia saligna)	Orange Wattle (Golden Wreath Wattle)	أكاسيا الأحراش	E	8	0.36
		Poinciana regia (Delonix regia)	Royal Poinciana	البونسيانا	E	47	1.89
	Fabaceae	Leucaena leucocephala	White Leadtree (River Tamarind)	اللوسينيا	E	2	0.09
Malvales	Malvaceae	Hibiscus rosa-sinensis	Chinese Hibiscus (China Rose)	الكركدية الأحمر (الورد الصيني)	E	719	31.98
		Hibiscus tilliaceus	Coastal Hibiscus	كركدية الساحل	E	34	1.51
		Brachychiton populneus	Kurrajong (Bottletree)	بودرة العفريت (براختيون رفيع)	E	4	0.18
Myrtales	Myrtaceae	Eucalyptus camaldulensis	River Redgum	الكينيا (الكافور)	E	6	0.27

Order	Family	Scientific Name	Common Name	Arabic Name	Native vs. Exotic	Number	%
		Callistemon citrinus (Melaleuca citrine)	Red Bottlebrush (Callistemon)	فرشاة الزجاج	E	3	0.13
		Psidium guajava	Guava	الجوافة	E	1	0.04
	Lythraceae	Punica granatum	Pomegranate	الرمان	E	3	0.13
		Lawsonia indica	Henna	التمر حنة	E	10	0.44
Sapindales	Sapindaceae	Dodonaea viscosa	Hopbush	الديدونيا	E	194	8.63
	Rutaceae	Citrus clementina	Clementine	الكلمنتينا	E	1	0.04
Rosales	Rosaceae	Rosa damascena	Damask Rose	الورد الجوري (الورد الدمشقي)	E	3	0.13
	Moraceae	Ficus elastica	Rubber Fig	التين المطاطي	E	3	0.13
		Ficus citrifolia	Shortleaf Fig	فيكس سيتريفوليا	E	4	0.18
		Ficus religiosa	Sacred Fig	تين لسان العصفور	E	2	0.09
		Ficus lyrata	Fiddle-leaf Fig	فيكس ليراتا	E	2	0.09
		Ficus nitida	Weeping Fig	التين متهدل الأوراق	E	131	5.82
		Ficus benjamina	Benjamin Fig "Starlight"	تين بنجامينا "مبرقش"	E	235	10.45
		Ficus carica	Common Fig	التين	N	4	0.18
		Ficus binnendijkii	Narrow-leaf Fig	التين رفيع الأوراق	E	10	0.44
Lamiales	Oleaceae	Olea europea	Olive Tree	الزيتون	N	33	1.47
		Jasminum officinale	Common Jasmine	الياسمين البلدي	N	2	0.09
	Bignoniaceae	Jacaranda mimosifolia	Jacarand	الجكرندا	E	3	0.13
		Tecomaria (*Tecoma*) *capensis*	Cape Honeysuckle (Tecomaria)	التيكوماريا الحمراء	E	2	0.09
	Verbenaceae	Lantana camara	Lantana	أم كلثوم (اللانتانا)	E	3	0.13
Malpighiales	Salicaceae	Populus alba	White Poplar (Silver-leaf Poplar or Abele)	الأبيض الحَوْر	E	12	0.53
	Passifloraceae	*Passiflora incarnata*	Purple Passionflower	الفلورا (البسفلورا)	E	2	0.09
	Euphorbiaceae	Acalypha wilkesiana	Jacob's Coat (Copperleaf)	الأكاليفا (النَّحاس)	E	64	2.85
		Ricinus communis	Castor-oil Plant (Castor Bean)	الخروع	E	9	0.40
Brassicales	Moringaceae	Moringa oleifera	Moringa	المورينجا (البان أو اليسر)	E	194	8.63
Caryophyllales	Nyctaginaceae	Bougainvillea specttabilis	Veranera	الجهنمية	E	90	4.00
Apiales	Araliaceae	Schefflera arboricola	Dwarf Umbrella Tree	الشيفوليرا المظلة القزمية	E	184	8.19
		Schefflera actinophylla	Australia Umbrella Tree (Octopus Tree)	الشيفوليرا المظلة (شجرة الأخطبوط)	E	4	0.18
	Pittosporaceae	Pittodprum tobira	Japanese Pittosporum	البتسبورم	E	2	0.09
TOTAL						2248	100%

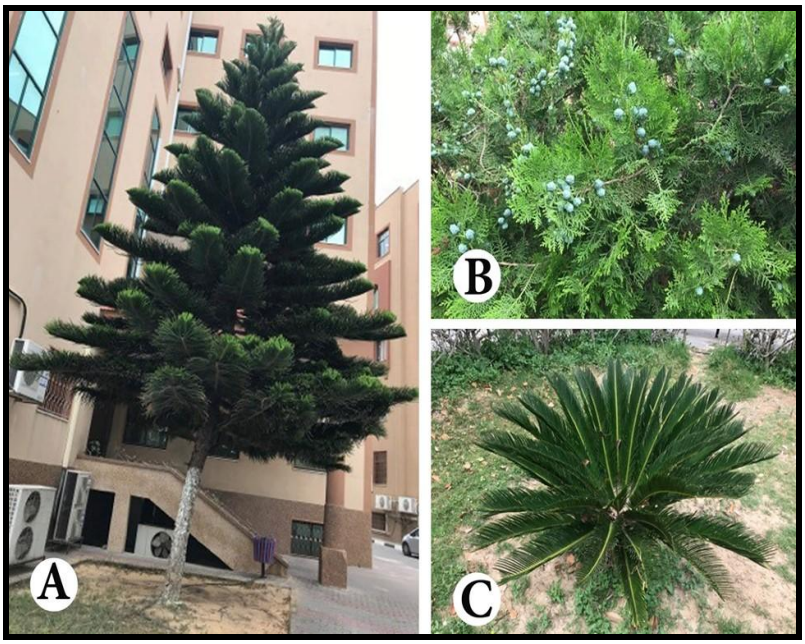

Figure 4: Gymnosperm trees and shrubs prevailing at MC-IUG: (A) Norfolk Island Pine Araucaria heterophylla (B) Oriental or Chinese Thuja Cypress Thuja orientalis (C) Japanese Sago Palm Cycas revoluta

Figure 5: Monocot angiosperm trees and shrubs prevailing at MC-IUG: (A) Date Palm Phoenix dactylifera (B) California Fan Palm Washingtonia filifera (C) Umbrella Papyrus Cyperus alternifolius (D) Elephant's Foot or Ponytail Palm Beaucarnea recurvata (Nolina recurvata)

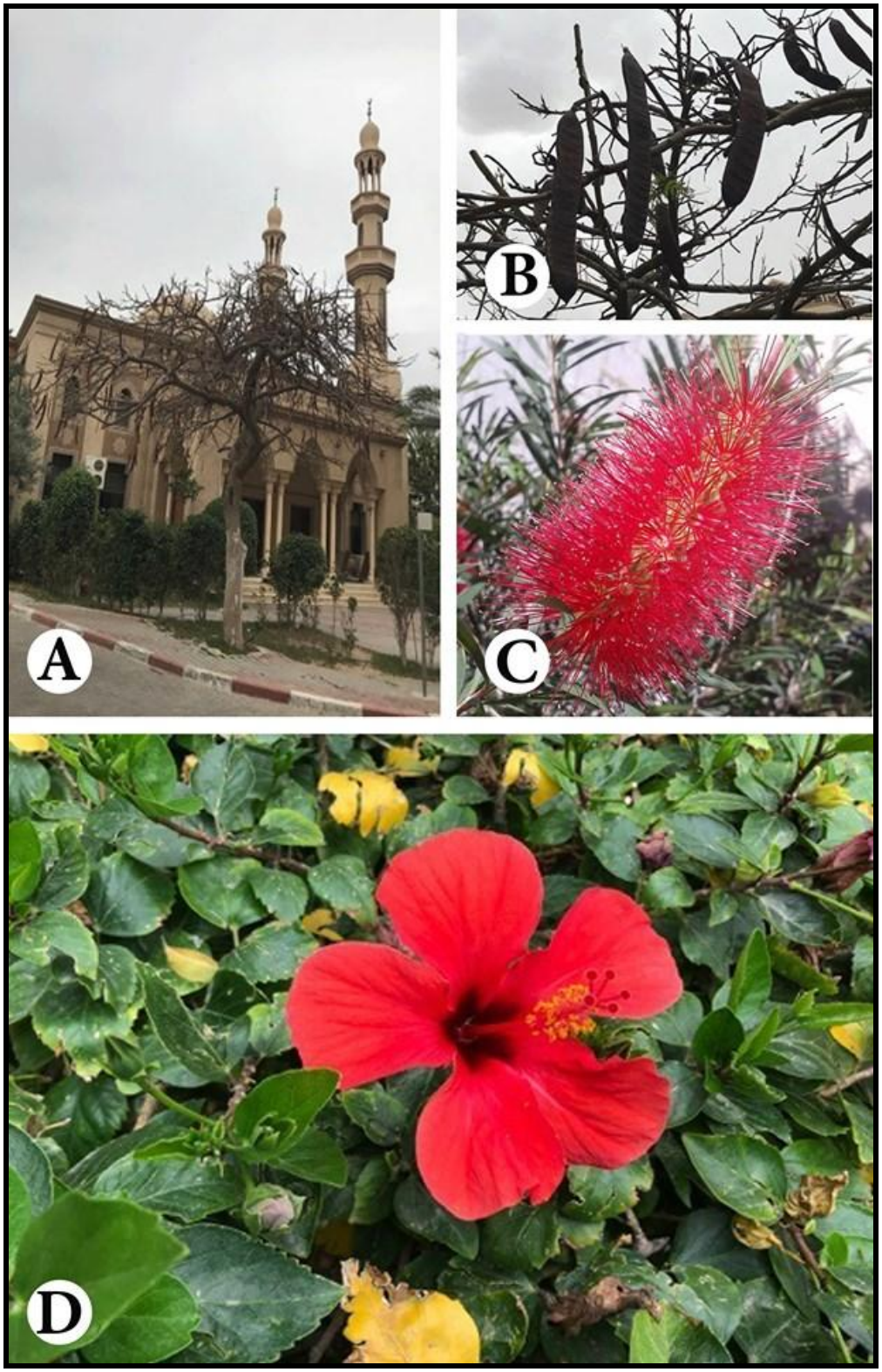

Figure 6: Dicot angiosperm trees and shrubs prevailing at MC-IUG: (A-B) Royal Ponciana Ponciana regia (C) Red Bottlebrush Callistemon citrinus (D) Chinese Hibiscus Hibiscus rosa-sinensis

Figure 7: Dicot angiosperm trees and shrubs prevailing at MC-IUG: (A) Weeping Fig Ficus nitida (B) Benjamin Fig Ficus benjamina (C) Olive Tree Olea europea (D) Dwarf Umbrella Tree Schefflera arboricola

IV. DISCUSSION

The current work revealed as many as 53 horticultural and agricultural tree and shrub species grown in MC-IUG. The great majority of the species recorded (92.45%) are exotic or non-native. These exotic species were introduced to Palestine from completely separate and far geographical areas via human intervention (Abu Ayyash et al., 2007). Analogous local works carried out by Abbas (2016) and Abd Rabou (2018) in other urban environments revealed similar results, where 80.4% and 94.0% of the tree and shrub species encountered at the two studies respectively were exotic. Planting of exotic species in local environments introduced several advantages. Exotic species may be free of native pests and diseases, and they may be immune to many pests of the new country they introduced to. The dense foliage and crown can be a refuge to both vertebrate and invertebrate fauna. Many deciduous exotic species can provide greater solar access to the locations they grown in through the autumn and winter months (Moro et al., 2014). In contrast, studies targeting the plantation of native tree and shrub species showed that the greater mortality in exotic species because of water scarcity and high salinity levels provided a more convincing reason for promotion of indigenous tree species (Oba et al., 2001). Accordingly, the selection of such exotic species to be planted in the Gaza Strip should be in correspondence with the environmental stresses prevailing there. The Gaza Strip is characterized by its arid to semi-arid environment in addition to water scarcity and high salinity levels of both water and soils (UNEP, 2003). Ecologically, there are a good value of native plants in benefiting bird fauna and other wildlife categories. This is because native species of plants and animals evolved together, so native plants are much more likely to provide the right mix of foods and support the insect and other invertebrate populations that birds and other wildlife need to flourish.

As far as the gymnosperms (conifers) are concerned, they are known as a conspicuous kind of evergreen trees or shrubs that are grown prominently in gardens and parks as well as in many managed forests in the Northern Hemisphere (Farjon, 2010). They were represented by only 5 species in the current study. The Norfolk Island Pine (Araucaria heterophylla) is a beautiful and attractive horticultural plant that is planted in most institutions, parks and home yards of the Gaza Strip. As many as 25 individuals of this species are distributed at MC-IUG, adding more

beauty and elegance to the place. It is one of the highest trees occurring there. The plant has an extensive global distribution and is grown as an ornamental in different countries worldwide (Farjon, 2010 and Patil et al. 2013). The widespread cultivation of the tree may be attributed to its beauty, conical shape, straight trunk, arrangement of its branches, high altitude, fast growth rate, low susceptibility to pests and diseases, adaptability to different soil conditions, high tolerances to drought and salt-laden winds as was pointed out by Gilman and Watson (1993a) and Farjon (2010).

The Evergreen Cypress (Cupressus sempervirens) is another gymnosperm that is commonly cultivated by the Palestinians as a border of orchards and agricultural fields. Hundreds of this species are planted as a border tree of the Al-Shuhada Cemetery, which is the main and largest cemetery in the northern parts of the Gaza Strip. The species is known to provide wind-break, shade and beauty characteristics. Moreover, Abd Rabou et al. (2008) pointed out that the species was harvested as a source of timber in the last few decades in the Gaza Strip. This pioneer Mediterranean species seems to grow quickly on most types of soils of Palestine including the rocky and compact ones (Abu Ayyash et al., 2007). It is well adapted to the Mediterranean climate which has dry and hot summers and rainy and cold winters (UNEP, 2003). Only 4 individuals of the King Sago Palm (Cycas revoluta) were found to be planted within MC-IUG. The IUG students have been found to take photos with this strange and amazing plant. Strangeness and surprise may have come from the fact that the cycads are the oldest and most primitive assemblages of living seed plants in the world. According to Zheng et al. (2017), these plants are considered as “living fossils” or "evolutionary relicts" because of their long evolutionary history. The King Sago Palm, which is not a true palm, is morphologically characterized by a palm-like habit, having short, unbranching trunks and crowns composed of large, evergreen and pinnate leaves. This plant seems to thrive both indoors and outdoors, and for this reason it was seen planted in shady places like homes and offices of some institutions in the Gaza Strip.

The monocot angiosperms were represented by only 9 species (16.98%) in the current study. The Date Palm (Phoenix dactylifera) is the commonest among the monocot angiosperms in MC-IUG. It is very prevalent horticultural and agricultural plants in the whole Gaza Strip as indicated by many local studies (Abbas, 2016; Radwan, 2017; Abd Rabou and Radwan, 2017a, 2017b and 2018 and Abd Rabou, 2018). The current number of Date Palm trees in MC-IUG (Table 1) is actually less than what was found years ago. This is because of the infestation of the Red Palm Weevil (Rhynchophorus ferrugineus) to the species in the Gaza Strip since late 2011. Tens of MC-IUG Date Palm trees were totally destroyed after their infestation. According to Radwan (2017) and Abd Rabou and Radwan (2017b), the introduction of infected offshoots from Egypt through earth tunnel trade and the ability of the adult weevil to fly long distance and cross borders seem to be main causes of the local infestations with this destructive insect pest. Along with the Date Palm, the California Fan Palm (Washingtonia filifera) was represented by 10 individuals only though it is very common species in Gaza roads, homes, parks, cemeteries, hospitals and other educational institutions (Abbas, 2016 and Abd Rabou, 2018). The municipalities of the Gaza Strip preferred to plant the species because of its low water requirements and high tolerance to drought and salinity (Jones, 1995); conditions characterizing arid and semi-arid locations like the Gaza Strip. Compared to the California Fan Palm, the Palestinians usually focus on planting the Date Palm everywhere in the Gaza Strip, including MC-IUG because the species is a Quranic plant and its fruits are delicious and are commonly used by the locals in different ways as mentioned by Abd Rabou and Radwan (2017a). Every year, the fruits of the Date Palm and Olive Trees (Olea europea) of MC-IUG are sold at auction to traders for local marketing and the profits go back to IUG treasury.

The dicot angiosperms were represented by 39 species (73.59%) in the current study, of which the Chinese Hibiscus or China Rose (Hibiscus rosa-sinensis) was the commonest where 719 individuals were recorded in MC-IUG. The plant with its deep red flowers is believed to have an Asian origin; hence the name "rosa-sinensis" meaning "rose of China". The species is a perennial ornamental plant that is widely cultivated in different urban localities within the Gaza Strip (Abbas, 2016 and Abd Rabou, 2018). It is used for urban landscaping and as an ornamental plant. In MC-IUG, the plant is commonly and extensively used as a living fence, bordering the small geometrical spaces and gardens that are cultivated with other different ornamental trees and shrubs. The preference of cultivating the species may be attributed to its glossy leaves and solitary, brilliant red flowers. It is worth mentioning here that cultivars of the Chinese Hibiscus with flowers of many colors are cultivated in MC-IUG. The 5-petaled flowers with their prominent orange-tipped red anthers add more beauty and elegance to the places, though the petals of different cultivars may be doubled or have different shapes.

University students are commonly found picking up the flowers for fun as well as beauty and glamorous color. Moreover, the characteristic flowers of the Chinese Hibiscus are often picked up for educational purposes at IUG biology laboratories. The flower parts are clear and are easily understood by students of General Biology, General Botany and Plant Morphology and Anatomy courses. Different species of bird fauna; especially passerines, are

commonly found either to imbibe the characteristic flowers or use the bushes of the plant for protection, nesting and resting purposes (Abd Rabou et al., 2007 and Abd Rabou, 2005 and 2019). The examples are the Palestine Sunbird (Nectarinia osea), House Sparrow (Passer domesticus), Yellow-vented Bulbul (Pycnonotus xanthopygos), European Robin (Erithacus rubecula), Bluethroat (Luscinia svecica) and Graceful Warbler (Prinia gracilis) (Abd Rabou, 2019).

Ficus species (family Moraceae) are the most common plants in MC-IUG and they were represented by 8 species. Of which, the Benjamin Fig (Ficus benjamina) including its "Starlight" variety and the Weeping Fig (Ficus nitida) are represented by 235 (10.45%) and 131 (5.82%) individuals respectively. The local studies of Abbas (2016) and Abd Rabou (2018) pointed out that the Ficus spp. are among the most common trees and shrubs of the main streets and green spaces of the Gaza City. The extensive cultivation of Fig trees and shrubs in the Gaza Strip and vast areas worldwide may be attributed to their cultural, environmental, ecological, economical, and medicinal values. Sawarkar et al. (2011) and Somashekhar et al. (2013) pointed out that Fig trees have profoundly influenced culture through several religious traditions. They added that these plants are reported to possess anti-diabetic, anti-diarrhea, anti-epilepsy, anti-inflammatory and ear drop properties. Moreover, they are an important source at a variety of chemical compounds. The Common Fig (Ficus carica) is a common fruit agricultural shrub that is extensively and intensively cultivated in the Gaza Strip, though it was represented by only 4 shrubs in MC-IUG. Its fruits are loved and respected by the Palestinians because they are delicious and mentioned in verse 1 of the Surat At-Teen in the Holy Quran.

Although the Royal Poinciana (Poinciana regia or Delonix regia) is exotic and deciduous, it is one of the most cultivated ornamental trees in the roads, refugee camps, home yards and parks of the Gaza Strip environment (Abbas, 2016 and Abd Rabou, 2018) including MC-IUG. The dark brown seedpods of the species are characteristic in having a size of about 50 cm long and 5 cm wide. These seedpods are commonly noticed by IUG students and the Palestinian community hanging from branches of the plant or falling on the ground. When accumulated in large numbers in certain localities within the Gaza Strip, some rural Palestinians may use these seedpods for fuel purposes. Such cultivation of the species in the local environment could be attributed to its fast-growing property, fern-like leaves and flamboyant display of flowers. The tree has an umbrella-shaped and spreading crown, having horizontal branches that form a diameter that is wider than the tree height. Moreover, the Royal Poinciana seems to tolerate drought and salty conditions (Gilman and Watson, 1993b) prevailing in the arid to semi-arid areas like the Gaza Strip.

Compared to other local green spaces and roads tree and shrub species, the Royal Poinciana usually grows to a modest height of 5-7 meters that is favorable by the Palestinian community. Its dense foliage also provides full shade needed by the Palestinians to the extent that they sometimes tie their donkeys, horses, goats and sheep with the plant trunks. Parking of cars and other transportation vehicles are mostly cultivated with the species for beauty and shade purposes. This species is one of the most widely cultivated ornamental plants in the world, being grown as an ornamental in gardens and by the sides and medians of roads throughout the world (Gilman and Watson, 1993b and Zuffo et al., 2016). This widespread distribution of the plant could be attributed to the phytochemical and pharmacological characteristics. In this regard, Modi et al. (2016) pointed out that the various parts of the plant are traditionally used for the treatment of different diseases including inflammation, rheumatism, bronchitis, diabetes, anemia, etc. The plant also possesses antioxidant, wound healing, larvicidal, antidiarrhoeal, diuretic, anthelmintic and other activities.

Although the Oleander (Nerium oleander) is extensively used as an ornamental plant in parks, along roadsides and in private gardens of the Gaza Strip (Abbas, 2016 and Abd Rabou, 2018), the study showed that only 11 individuals are identified in MC-IUG, where only one individual was recorded on MC-IUG ground, while the other ten were planted above the main mosque of IU-IUG. The plant grows naturally in Wadi Gaza Nature Reserve (Abd Rabou et al, 2008). During the last few decades, the Oleander was extensively cultivated in MC-IUG. The toxicity of all parts of the plant was said by IUG gardeners to be a capital factor enhancing the eradication of the species from MC-IUG horticultural plots and corridors. In this regard, Abbas (2016) pointed out that the species prevails in Gaza main streets because of its expected tolerances to pests, drought, poor soils, air pollutants and water shortage, though it is poisonous and unpalatable by grazing animals. Many studies confirmed the toxicity of the Oleander on humans and various categories of animals (Szabuniewicz et al., 1972; Langford and Boor, 1996 and Omidi et al., 2011).

The Hopbush (Dodonaea viscosa) is a cosmopolitan shrub species that is commonly recorded in the corridors separating the horticultural plots in MC-IUG. The Hopbush is an actual erect to spreading shrub growing from 1.5 to 4 meters tall. It is a common species in Gaza hospitals, parks and main streets as well, where it seems to tolerate the harsh environmental conditions of the Gaza Strip (Abbas, 2016 and Abd Rabou, 2018). The dense evergreen foliage of the Hopbush is an excellent refuge for many passerine birds prevailing in MC-IUG as indicated by Abd Rabou (2019). Local people were sometimes found to use the trimmed parts of the plant as firewood or fuel material. In the

roads of the Gaza Strip, it is a common feature to see sheep and goats grazing on road woody plants including the Hopbush. The actual absence of pastures and grazing lands in the Gaza Strip promotes the overgrazing of domestic animals on the palatable woody plants prevailing in the natural, agricultural and urban ecosystems (Abd Rabou et al., 2008). Harrington (1979) studied the effects of feral goats and sheep on the palatable shrub populations, of which the Dodonaea viscosa was a part. He pointed out that grazing by sheep or goats reduced the establishment of Acacia aneura and Dodonaea viscosa seedlings.

Knowledge on the benefits of Moringa (Moringa oleifera) among Gazans as a fodder or edible plant is escalating day by day. Although the Moringa was found to be cultivated in a few numbers in Gaza parks (Abd Rabou, 2018), more than 190 individuals were recoded in a marginal area lying in the western side of MC-IUG. Discussions with IUG gardeners revealed that the plant was planted for experimental uses. In other areas of the Gaza Strip, a few farmers cultivated the plant for nutritional uses to humans or livestock, where many parts of the species are edible. The leaves are the most nutritious part of the plant, being a significant source of many vitamins and nutrients. Varmani and Garg (2012) and Abdull Razis et al. (2014) pointed out that the Moringa oleifera is a multi-purpose herbal plant used as human food and an alternative for medicinal purposes worldwide. It is commonly used in spices and cosmetic oils. The leaves-content of essential amino acids, carotenoids and components with nutraceutical properties promoted the use of the plant as a nutritional supplement or constituent in food preparation.

The Dwarf Umbrella Tree (Schefflera arboricola) is one of the common ornamental evergreen shrubs prevailing everywhere in MC-IUG (N=184). The indoor and outdoor cultivation of the plant there reflects the plant ability to adapt to a wide variety of light levels. It is described as a "dwarf" in its common name because it appears to be a smaller version of the Australia Umbrella Tree or Octopus Tree (Schefflera actinophylla), which was also recorded in MC-IUG (N=4). The Dwarf Umbrella Tree is characterized by its palmately compound leaves which have from 7 to 9 leaflets. At MC-IUG, numerous leaf colors and patterns are usually seen, often variegated with creamy-white to yellow edges or centers. As there are a range of garden plants that are considered poisonous, IUG gardeners claimed that the Dwarf Umbrella Tree is one of these plants. This claim appears to be consistent with Johnson and Johnson (2006) who ensured the toxicity of many garden plants having a wide distribution worldwide, of which the Dwarf Umbrella Tree is a clear example.

Although it was represented by only 6 individuals in the current study, the Eucalyptus camaldulensis is a common and famous tree species that was planted in the Gaza Strip since decades and perhaps centuries. The plant seems to be resistant to high levels of drought, temperatures and salinity. According to Al-Zaghat (1997) and Al-Zaghat et al. (1993), the Eucalyptus spp. have many economical, environmental, ecological and natural benefits. The Eucalyptus spp. trees are good for setting up windbreaks, green belts and landscaping. The trees work to adjust the local climate and temperatures, stabilize the soil, and cultivate marshes and abandoned lands. The plant is a good source of wood, timber, honey production and aromatic and medicinal materials. Many of these benefits were achieved in the Gaza Strip as pointed out by Abd Rabou et al. (2008). As far as the Castor-oil Plant (Ricinus communis) is concerned, the species is wild in the sense that it can establish itself easily where its seeds can reach and can often be found on wastelands. In the Gaza Strip, the species flourishes in disturbed areas, roadsides, wadis banks (Wadi Gaza, Wadi Beit Hanoun, Wadi As-Salqa), edges of wastewater treatment lagoons, agricultural lands, marginal areas, etc. (Abd Rabou et al., 2008).

The presence of many species of fruit trees and shrubs at MC-IUG and other green spaces in the Gaza Strip may be advantageous in the sense that they provide food for both people and wildlife. The fruit trees and shrubs; namely the Date Palm (Phoenix dactylifera), Olive Tree (Olea europea), Common Fig (Ficus carica), Pomegranate (Punica granatum), Clementine (Citrus clementina), Guava (Psidium guajava), which were recorded in the current study, are more or less represented in such urban environments within the borders of the Gaza Strip (Abbas, 2016; Radwan, 2017 and Abd Rabou, 2018). Such presence of fruit plants may be disadvantageous in the sense that the fruits of trees and shrubs can pollute the grounds by increasing the waste level, and attract annoying insects and harmful rodents. These facts were found to be consistent with the findings of many studies dealing with urban fruit trees and shrubs (Barker, 1986 and Ferrini and Fini, 2011). Finally, the selection of woody species corresponding with the prevailing local environmental and ecological conditions in the Gaza Strip is very essential.

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